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Space perception of the blind.

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Space perception of
the Blind.

Hoffding: Outlines of psychology.

Space perception of the Blind.

7. (a) In respect also of superficial extension, the attempt has been made to explain the apprehension of space through association of visual sensations with representations of touch and movement. What is immediately apprehended would then be composed of sensations of a certain quality, and the apprehension of space would result from the fusing of these with certain representations. It is natural to believe, and the belief is confirmed by observations of new-born infants, that sight at first embraces only light and colours. The excitations which are clear and bright, but not too dazzling, are sought out and the endeavour made to retain them; it is only later that the form of the object is apprehended.¹ Through percepts and experiments made with touch and by the movement of one or several organs, the limits of individual objects come to be known to us. The language of the visual sense becomes perfectly plain only by means of sensations of movement and touch. On the other hand, sight, when once it has developed hand in hand with the above-named senses, plays quite the greatest part in our apprehension of space. There now arises the question, whether the blind, who are confined to sensations of touch and movement, do actually have an intuition of space similar to that of persons with sight. We, who can see, conceive of space as a visible surface at a little distance from us; but how can a blind man actually picture to himself space?—Here appears the real paradox involved in saying that space is a psychological product. For if the exclusion of the visual images leaves only a something which is not the same in kind as visible space, we shall not be able to say what space is in itself, since in this case no definition can be given which will

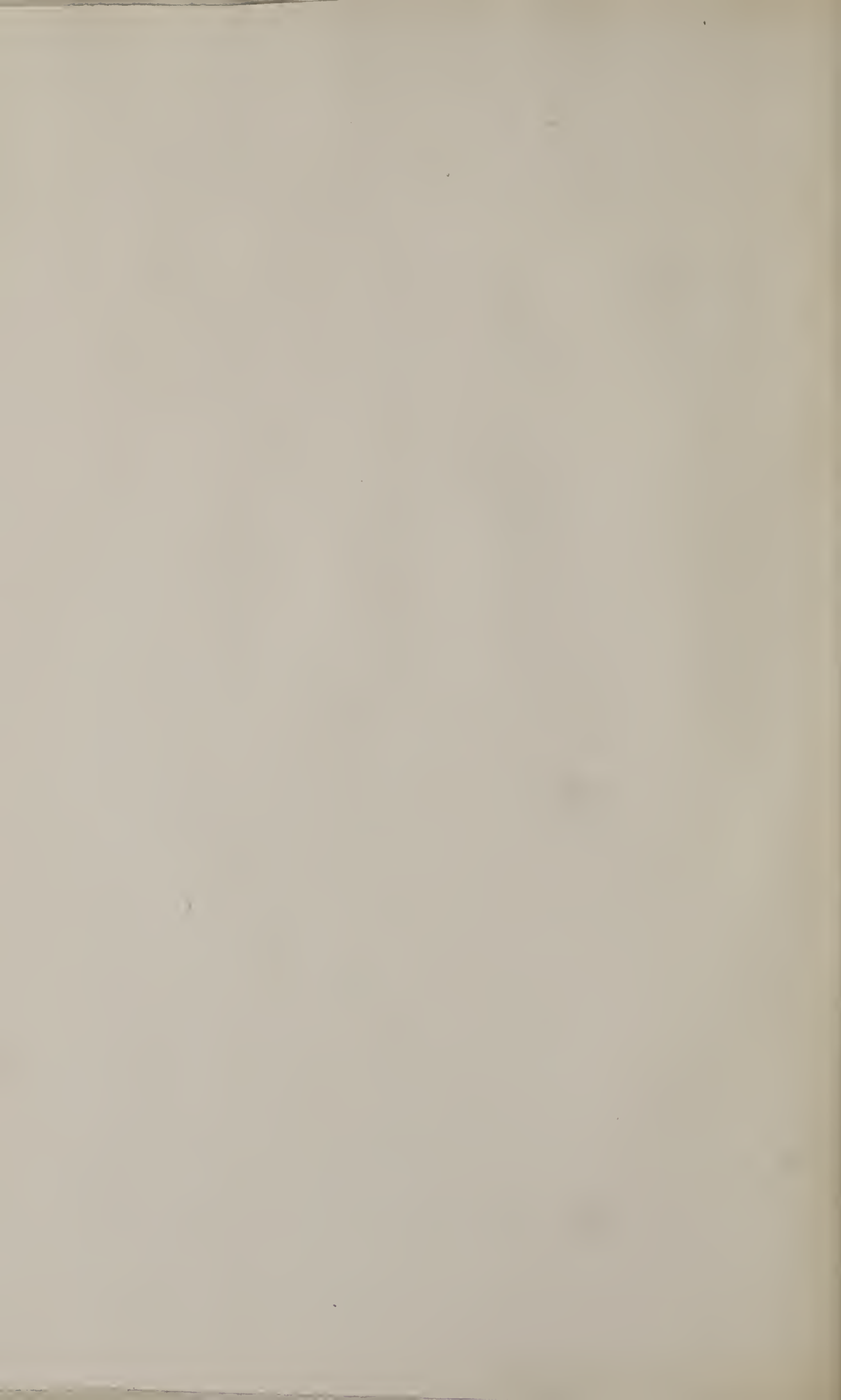
¹ According to Preyer (pp. 36, 41) (Eng. trans. pp. 42, 52), a child's seeing is in the first few days only an obscure sense of bright and dark.

serve for both the visual and the tactual space. There would then be no more natural connection between the visual space and the tactual space, than between the name and the things denoted by it.

There is actually to be had a definite observation on this point. Ernst Platner writes in his *Philosophischen Aphorismen*;¹ "As regards the idea of space or extension acquired without sight, the observation and examination of a person blind from birth, which I have carried on for three weeks, have more than ever convinced me that the sense of feeling (touch) is in itself absolutely ignorant of what pertains to extension and space, and knows nothing of a local separation between things. I am convinced, in brief, that the sightless man perceives absolutely nothing of the external world, except the existence of something acting, which may be distinguished from the feeling of self (general sensation) suffering it, and for the rest merely the numerical difference—shall I say of impressions or of things? In reality to the blind, time serves instead of space. Nearness and distance mean to them nothing more, than the shorter or longer time, the smaller or greater number of feelings [sensations], which he requires, in order to get from one feeling [sensation] to another. The fact that the blind person employs the language of sight, may very well deceive, and did deceive me when I first began my investigations; but in reality he knows nothing of things as outside one another, and (this especially I have observed very plainly), if the objects and the different parts of the body with which they come in contact did not make *different* kinds of impressions on the sensory-nerves, he would regard everything external as one thing, that acts successively upon him, *e.g.*, more strongly when he places his hand on a surface than when he lays a finger on it, more faintly still when he strokes a surface with his hand or passes the foot over it. In his own body he distinguishes between head and feet not in the least by distance, but merely by the incredible fineness with which he can recognize differences in the feelings [sensations] experienced in the one or the other of these parts, and also by time. In the same way he distinguishes the form of other bodies purely by the kinds of the feelings [impressions on the sense of touch], since, *e.g.*, a cube, through its corners and sides, affects the sense of feeling (touch) differently from a sphere."

We have an approximation to the space-perception of the blind,

¹ Leipzig, 1793, p. 466, *seq.*



when we try to find our way in a dark room. Only we have the advantage, that the visual space lies ready in the background, and may be brought to our assistance in the interpretation of the sensations of touch and movement. It is something similar when we concentrate attention on the tongue and—with the visual sensations as far as possible discounted—observe what apprehension of space it affords us. For the tongue is like a blind man, and yet has an excellent acquaintance with its surroundings.

(b) However, there still remains a possible way of maintaining the originality of the apprehension of space. Motor-sensations are, indeed, always successive; but by means of the sense of touch we can receive several impressions simultaneously. In like manner several rays of light may fall simultaneously upon the retina. Now may not this afford the possibility of an immediate apprehension of the excitations as arranged in space? It might seem even necessary to suppose this. For sensation of a colour really means sensation of a coloured surface; if the coloured object were only a mathematical point, it would afford no excitation. Even if larger objects are apprehended only through movement of the organs of sight and touch, it might still be thought that small objects could be apprehended immediately, without successive process. There must be an immediate distinction between the impression of a shilling and that of a threepenny bit. The apprehension of small surfaces would then be the minimum, to which “nativism,” the theory which maintains the originality of the apprehension of space, would be reduced, the final stronghold from which it could not be expelled.¹

It cannot, of course, be denied, that we may receive and con-

¹ Cf. Stumpf, *Der Psychologische Ursprung der Raumvorstellung* (“The Psychological Origin of the Idea of Space,”) Leipzig, 1873, p. 56—71.—Professor Mahaffy of Dublin gave an account, in a letter in *Mind*, 1881, p. 273, *seq.*, of an interview with the blind man cured by Franz. This man, a doctor in Kingstown, declared that he saw and distinguished forms immediately after receiving sight, and that outlines and forms were as the sense of touch had led him to expect. Mahaffy regarded this as the testimony of a competent judge in favour of the originality of the power to distinguish form through sight alone. But neither this interpretation nor the facts of the case accord with the report of Dr. Franz given shortly after the operation, in *Philosophical Transactions*, (1841). As mentioned above, the patient perceived a cube as a square, and a sphere as a circle. When Franz begged him to describe the impressions which the objects made on him, he said that he noticed at once a difference between the cube and the square, but was unable to form the idea of a square or of a disk, until he had felt in his finger-tips a sensation, as if he really touched the objects (*Phil. Trans.*, 1841, i, p. 65). He had thus to make an actual translation of the language of the one sense into that of the other, before he could recognize forms. There remains in favour of nativism, only the fact that he at once noticed a difference in the forms. But even in this the experience of the sense of touch may have helped. His attitude towards the forms was not that of a consciousness without any experience; not, that is to say, the attitude of the earliest consciousness.

tinually retain a host of simultaneous sensations of light and contact, and that we perceive them immediately as arranged in space. On the other hand, it is not so certain that the earliest consciousness has the same perception. A great variety of simultaneous impressions will at first take effect rather as a collective mass, will yield one single chaotic sensation. And as the quality and the strength of the impression cannot be at once distinguished, so also the space-relation cannot be from the first apprehended in its own right, but would so to speak conceal itself in a higher degree of strength, or, to make use of Bain's expression, in a greater massiveness of the impression. The account quoted from Platner points in this direction, for it shows that only qualitative differences of impression induced the blind patient to recognize diverse phenomena distinct from self. Reference may also be made in this connection to Weber's experiments, which proved that the degree of warmth seems higher when the whole hand is immersed in warm water, than when the finger only is immersed. As it cannot be supposed that there is an innate idea of the difference between the fingers and the hand, this difference in strength would be at first the only thing apparent.

A purely passive apprehension of simultaneously given impressions can only be momentary. The activity is at once excited, the eye moves along the surface, or the hand touches it. At once, then, simultaneity passes into succession, the intuition becomes discursive. We apprehend moving objects more quickly and easily than objects at rest, and when the objects do not move, we move relatively to them. Two successive excitations on the skin can be distinguished with a smaller distance between them than two simultaneous excitations. The lowest animals and new-born infants do not notice any simultaneous differences in their surroundings, while they can apprehend successive differences (changes) (*cf.* p. 114). By movement things are discovered and apprehended, which would otherwise remain unnoticed. The first chaotic sensation will consequently be determined by a series of succeeding sensations, in which from the nature of the case the motor-sensations take a prominent place.

It might even be maintained, that successive and discursive apprehension is a necessary presupposition of true apprehension of space. Space signifies a relation. By something being in space is meant, that it occupies a certain position in relation to other things, and that its several parts occupy certain positions relatively to one

another. Instead of speaking of space in general as an integral unity, it is better to make use of the more elementary conception "position." It is then apparent, that the apprehension of space rests on a comparison or a combination. It cannot therefore subsist as given from the first, but presupposes a certain psychological activity.

(c) It is not a matter of indifference, which part of the body meets with an excitation from the external world. As it is by successive experiences that we learn to know our own body, as well as the world surrounding us, it cannot be supposed that we can originally know or feel on which part an excitation lights. If, then, the excitations do, nevertheless, act differently on the different parts, this difference can appear to consciousness only as a certain shade, a qualitative side-determination of the sensation. The special character which the sensation receives, from the fact of the excitation lighting upon one single definite point, Lotze calls its *local sign*. The conditions are different at every point of the skin and of the retina; there must therefore be a variety of local signs. As regards sight, these local signs may consist either in the motor-impulses, different for each point, which aim at turning the eye so that the excitation of light may fall on the yellow spot (Lotze), or in the different quality of the sensations at the different parts of the retina (Wundt). In respect of the sense of touch Lotze finds the local signs given in the different secondary sensations, which one and the same touch produces by reason of the difference in thickness and tightness of the skin and the different underlayers which it encloses at different points.¹

Let us suppose that the excitation A falls upon a point in the retina at some distance from the yellow spot, and that it then attracts our attention. The eye will then be moved in such a way that A will fall upon the yellow spot. Answering to this movement, there will be a motor-sensation, which we shall call π . Now let A on another occasion fall upon a different point in the retina, and the motor-sensation which will be similarly occasioned, will also be different (K). We may then compare $A + \pi$ and $A + K$, and the conscious difference, resulting from the difference in the point on which the excitation has fallen, can now be apprehended. Again, if the excitation B falls upon the same point in the retina as previously A , it will be combined with the same motor-sensation.

¹ Lotze has given several accounts of his theory of local signs, the last in *Grundzüge der Psychologie* (1881). As regards Wundt, see *Physiol. Psychol.*, 11, pp. 25, 28, 163 (3rd ed. pp. 30-33, 191).

Between $A + \pi$ and $B + \pi$, there will then be found a likeness connected with the point in the retina concerned.—In this way a consciousness corresponding to the local relations is gradually framed.¹

These local signs can at first take effect only by successive apprehension. Consciousness cannot experience them all at once; only after the whole series has been gone through, can each of the sensations with its local sign be assigned to its definite place. If their determination is to be perfect, therefore, the local signs must make up a connected system. Excitation of a single point on the skin or the retina may then lead to a determination of locality, without the whole series of local signs being gone through afresh; for it is in this as in all cases where we have often gone through a series of different sensations or ideas, as the result of practice, the whole series comes at last to seem the object of an immediate intuition or of an intuitive knowledge (*cf.* p. 163, *seq.*).

8. But in spite of all this, the real apprehension of space is not yet explained. We have obtained a coherent group of motor-sensations, local signs, and sensations of light and contact, combined according to the laws of association. But no arrangement of all this is yet given, which would give rise to the intuition of an image, with its several parts placed one outside the other, and it outside our self (or rather outside the image of our organism); for all these sensations were qualitative and intensive, not extensive.²

Here it appears that all theories of the apprehension of space are at a loss. The so-called "nativistic" theory regards the apprehension of space as given with the very first impressions.³ According to it, all psychological explanation of the development of the apprehension of space is as superfluous as impossible; the apprehension of space must be accepted as *a priori*. But the experiments quoted above (6, 7 *a* and *b*) seem to contradict this theory. Every imperfection and every error in localization and apprehension of space

¹ *Cf.* my treatise on "Lotze's Doctrine of Space and Time," in *Philosophische Monatschr.* (1888), p. 126, *seq.* The Swedish writer, Reinhold Geiger, had previously (*Philos. Monatschr.*, 1888) pointed out gaps in Lotze's theory of local signs, which I endeavour to fill up in the way above indicated. [The above paragraph and note are inserted at Prof. Höffding's request. (Tr.)]

² [*Cf.*, however, the later recognition of "extensity" or "extensiveness" (Bain's "massiveness") as a property of sensations, and the new turn consequently taken by the discussion. (Dr. Ward in *Ency. Brit.*, vol. xx., Art. "Psychology," pp. 53-55, and Prof. W. James's articles on the "Perception of Space," *Mind*, 1887.) (Tr.)]

³ The most important representatives of nativism are at the present day Stumpf, from the side of psychology (*Der Psychol. Urspr. der Raumvorst.*), Hering from the side of physiology (his last work is *Der Raumsinn und die Bewegungen des Auges*, Hermann's *Handbuch*, iii, 1).



really contradict it, while they are to be explained very easily if the apprehension of space is itself a result of experience. For this reason the genetic theory regards space as a psychological product, caused by combination of intensive and qualitative sensations according to the general psychological laws of the association of ideas. But there still remains an unexplained residue, for the psychological product has a property not possessed by the elements out of which it has arisen, that very property which gives rise to the problem, namely, the extensive form. The attempt has, indeed, been made to explain the transition from the apprehension of successive stimuli to the intuition of the extended, by saying that the intuition of space forms of itself when it is indifferent from which end we begin the reproduction of a series of sensations ; for time has but one direction, space on the other hand several. Ultimately the whole series would be presented to us at once, wherever we might begin. But the utmost that we should arrive at in this way, would be simultaneity in time (co-existence) and not space. And a series of sounds may be repeated forwards and backwards, without being arranged as simultaneous—or as spatial. A transformation must therefore be admitted, a psychical synthesis, analogous to the chemical synthesis, out of which arise compound substances with properties not possessed by the elements (*cf.* p. 163). In this synthesis the visual sensations play, for all who have sight, the most important part, and are the customary language into which the contributions afforded by the other senses are translated.—Whether a corresponding synthesis also takes place for the blind, with the sense of touch in the ascendant, seems from Platner's account to be doubtful.

Even if it were the case, that tangible and visible minima were apprehended as extended, it would still be necessary to postulate a synthesis. For our space-images are continuously, uninterruptedly connected ; but neither the retina nor the surface of the skin afford the basis of such a continuity. In the retina, there is even a point quite impervious to excitations of light, the "blind spot," where the visual nerve enters the eye ; but there is no similar gap in our visual image ; we thus involuntarily fill up the gaps in the series of the sensations. Every theory, therefore, which does not represent the apprehension of space as given from the first "at one stroke," must in some form or other call in the constructive power of consciousness.

Such an appeal is not without its dangers. To a psychological

conception, which finds the essential character of consciousness expressed in synthesis, in the bringing together into unity and connection (II. 5. V. B. 5), it might seem highly probable that this fundamental form should be repeated in the separate mental processes. But it is one thing to hit upon the true characteristic of consciousness as a whole, quite another to utilize the said characteristic as a *deus ex machina* in special psychological problems. An opening might thus be easily afforded to arbitrary judgments; into such a psychical synthesis anything might be read. For this reason Lotze sets to work with the utmost circumspection, maintaining that his theory of local signs is not intended to explain the actual apprehension of space, but only the motives and aids of the mind when it gives shape to its spatial images. That the mind forms spatial images in the first instance out of certain of its sensations, Lotze regards on the other hand as a capacity which must be accepted as a fact, or as an impulse which is open to no further explanation.

The genetic theory is then only in complete opposition to the nativistic, when it goes so far as to hold that all the conditions for the development of the apprehension of space are given in the experiences of the single individual. This view is, however, improbable, on account of the unexplained residue which remains over, when we compare the elementary sensations with the fully developed apprehension of space. If in the synthesis to which this owes its definitive origin, we recognize the expression of a constructive power operating instinctively, then the question as to the origin of this power will refer us from the single individual back to the system of nature within which it takes its rise. The experiences which cannot lead to the given end in an individual life-time, may during the evolution of the race have gradually led to such an accommodation of the organization that inherited dispositions supplement what is insufficient in the individual experiences. The evolution hypothesis, first applied to this province by Herbert Spencer (1855), affords the prospect of tracing the problem farther back than was possible while psychology was confined to the experiences of the individual life.

How close the genetic and nativistic theories may approach is to be seen from the fact that, while on the one side it is allowed that the immediately given knowledge of space may be infinitely small as compared with what is added by association, and that in the original sensations there is really given only a



possibility of definite apprehension of space (Stumpf), on the other side it is intimated that everything may be so prepared in the organism, that the time between the first excitation of light on the retina and the origin of the idea of space may become infinitely small (Wundt).¹

9. But whether the "nativistic" or the genetic theory is adopted, it remains a necessary presupposition for the apprehension of space, that a definite organic basis should be present. The conflict of theories concerns, or should concern, only the point, whether the functions conditioned by the organization come *at once* into action or require a preparation and practice of a certain duration.

To give the more exact account of the organic structures which are of importance to the origination of the apprehension of space, is the business of the physiology of the senses.² Here reference will only be made, in addition to what has been already implied, to the importance of the central mechanism, which makes a close association between the sense-stimuli and the muscular movements of the sense organs possible. As regards the sense of touch the *optic thalamus*, as regards sight the *corpora quadrigemina*, seem to be the centres through which this association, and with it the physiological expression of the psychological synthesis, is accomplished; but the cerebrum probably plays a part also.

The apparatus thus lying ready is perhaps able with some animals (*cf.* 6) to function immediately after birth, so that the experiences necessary to the apprehension of space are at once and easily gained. With human beings, as it seems, several months elapse before so much is attained.

10. So far we have spoken of the actual form of space and of the faculty of intuiting spatial images. As to the *idea of space*, as a general, or rather as a typical individual idea, this is evolved

¹ Stumpf, *Der Psychologische Ursprung der Raumvorstellung* ("The Psychological Origin of the Idea of Space"), p. 114, *seq.*, 184.—Wundt, *Physiol. Psychol.*, ii., p. 164 (3rd ed., p. 207, *seq.*). *Cf.* also Spencer, *Principles of Psychology*, ii., p. 203, *seq.*

² See in this connection, Panum, *Sanserne og de Vilkaarige Bevægelser* ("The Senses and Voluntary Movements"), pp. 234-238; and Wundt's very full account (ii., chaps. 11 & 13).—In the above investigations only the most important psychological points of view are taken into consideration. We must refer any one who wishes to enter into the special psychological and physiological questions opened up by the theory of the apprehension of space, to Wundt's work, where the whole material is to be found collected and critically treated.—The question whether the axioms of geometry are based on our faculty of intuition as determined by our organization, or whether with sufficient practice we could form an idea of, and clearly describe, space with other properties, comes under epistemology, not under psychology. From the purely logical point of view, such a possibility cannot of course be disputed, but as a matter of fact, we are restricted to our space as characterized by the axioms of Euclid's geometry, until our organization shall have sustained a change by accommodation to other conditions of existence.

in the same way as the idea of time (1—3), by the attention being directed to the schema common to all individual spatial images, and to its possible expansion. At first the idea of space is limited. The patient operated on by Cheselden, could not picture to himself lines in space extending beyond the limits of his visual orbit. He knew that the room he was in was only part of the house, but could not grasp the fact that the whole house might look larger than the room. The power of applying the individual ideas symbolically, was still wanting. When this power is developed, it is discovered that no limits can be set to the subdivision or to the expansion of space, any more than of time.

The infinity of space (as of time) signifies that every limit of space is accidental, and can be overstepped in imagination. Absolute space, all the points and parts of which are perfectly homogeneous and continuous and which has no space beyond it, is a mathematical abstraction without a counterpart in psychological intuition. Psychological space is relative; it presupposes certain points of reference as given, and its parts do not appear with strict continuity and homogeneousness. In our apprehension of space, we make always greater or smaller leaps (as, *e.g.*, in letting the eye stray from one point to another), and the difference in content gives to each part of space a certain *qualitative difference* in our apprehension and intuition.

D.—The Apprehension of Things as Real.

1. Sensations, ideas, and concepts are forms under which the cognitive elements of the conscious content appear and are arranged. We have traced this arrangement from its simplest stage in the interaction of sensations, up to its highest stage in the activity of thought and of imagination directed to definite problems. The governing laws were essentially the same throughout. The motive of the advance from an involuntary arrangement in the play of sensations and ideas to scientific thought and artistic imagination, lay in the criticism necessarily brought in with growing experience. Fresh differences and contrasts require fresh activity, that the connection and the unity may be maintained and chaos overcome. The logical principles and the æsthetic rules, though it is not the business of psychology to lay them down, develop, nevertheless, according to natural psychological laws and prove thereby their intimate connection with

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